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Forest Products Laboratory's

Newsline

Summer 2016

Yreka Hoping for a "Eureka!" Moment: California Town Site of Nanocellulose Study

By Rebecca Wallace

Yreka, California (population 7,605), is a town surrounded by forests but hit hard by mill closings over the past 25 years. Forest Products Laboratory (FPL) scientists, along with many partners, are conducting a feasibility study to see if building a nanocellulose production facility in Yreka could help revive industry there while spurring forest restoration activities.

Local officials are enthusiastic about what a production facility could mean for jobs, economics, and forest health in this rural Northern California area. "They are interested in being a little bit more of a part of the future than of the past," said Forest Products Laboratory supervisory research chemist Alan Rudie.

Ian Shackleford

Nanocellulose is part of the emerging field of nanotechnology. Nanocellulose materials are strong, lightweight, colorless, and biodegradable. Possible uses may include lightweight armor, ballistic glass, car body panels, computer cases, food storage, and flexible electronics. Other products, such as concrete and structural panels, can be strengthened with the addition of nanocellulose.

The Yreka Cellulose Nanomaterials Project began in 2014, when the Siskiyou County Board of Supervisors met with Forest Service officials. From that meeting came a proposal to evaluate the possible construction of a commercial-scale cellulose nanomaterials production facility in Yreka, California. Yreka was identified as a promising location because of the plentiful supply of wood and support from local government.

Rudie explained two different focuses of the project. One part of their work is to help develop commercial uses for cellulose nanomaterials, which has been happening at FPL since a nanocellulose pilot plant was constructed there in 2011.

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FPL Assistant Director Wins 2016 TAPPI Award

By Francesca Yracheta

FPL Assistant Director Ted Wegner

Forest Products Laboratory (FPL) Assistant Director Ted Wegner recently received the 2016 TAPPI Nanotechnology Division Leadership and Service Award.

Wegner's experience in leadership, pulp and paper, and nanotechnology sprouted decades ago and continues to grow as his knowledge does. Wegner started his scientific career at E.I. Dupont in 1972 and joined the USDA Forest Service some years later, in 1977.

In 2004, he co-chaired the inaugural U.S. Conference on Nanotechnology for the forest products industry. Wegner helped organize and lead the association's International Nanotechnology Conferences from 2006 until 2011. That year, he was elected Secretary upon the launch of TAPPI's International Nanotechnology Division.

Wegner added another achievement to his repertoire when he received the Andrew Chase Award from the American Institute of Chemical Engineers in 2011. He was inducted into the Paper Industry International Hall of Fame in 2013.

As the leading association for the worldwide pulp, paper, packaging, and tissue industries, TAPPI provides networking opportunities and resources for members of the scientific community. The nonprofit organization strives to connect experts in science and education with innovative and groundbreaking information, and each other. Along with pulp and paper advances, TAPPI also explores bioenergy and biofuels, renewable chemicals, sustainability, and nanotechnology.

TAPPI honored Wegner with his most recent award in June at the 2016 International Conference on Nanotechnology for Renewable Materials in Grenoble, France.

Continued from page 1 ~ ## Yreka Hoping for a "Eureka!" Moment

The other focus is on preliminary designs for a cellulose nanomaterial production facility in Yreka. Industry and university cooperators are studying six different methods of isolating cellulose nanomaterial. Rudie and his partners expect that in 2016 they will identify one or two designs to further explore. Actually building a facility would require a more detailed design and an industry investor.

Dan Blessing, Natural Resources Officer for the Klamath National Forest, is the local Forest Service contact for the Yreka Cellulose Nanomaterials Project. Dan emphasizes how operation of such a facility would benefit natural resource management on the Klamath National Forest.

A nanomaterials production facility would benefit natural resource management on the Klamath National Forest.

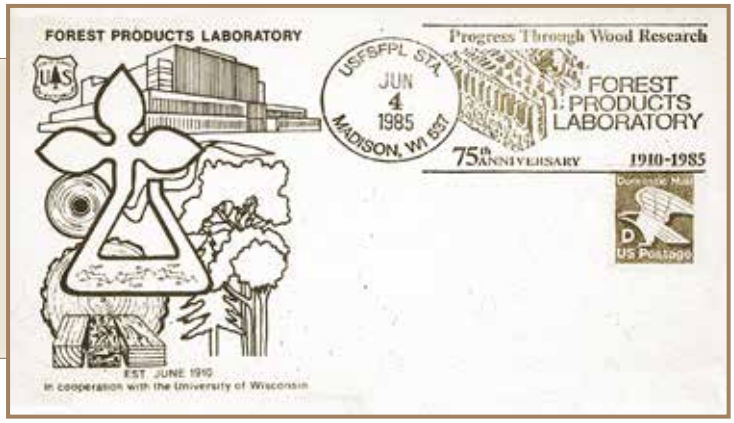
"To help restore fire-resilient ecosystems here on the Klamath National Forest, we need to reduce forest fuels. We have a market for mid-sized trees when we do thinning or fire salvage. But much of the fuels on the Forest are smaller diameter trees," said Blessing. "Removing the smaller diameter trees is expensive, and there are limited local facilities that have much use for them. Finding a market for cellulose nanomaterials and encouraging construction of a local facility to produce the materials will create a demand for the smaller diameter trees that will reduce the costs of local fuel reduction, benefiting our public forest and providing local jobs."

Blessing emphasized that the project is still in its early stages. "While the commercial properties of cellulose nanomaterials are promising, much work remains. We're hoping at least one industry partner will find the materials valuable enough to warrant construction of a larger facility. By having preliminary design of such a facility complete, maybe we can encourage a partner to build it here in Yreka."

The nanocellulose pilot plant at the Forest Products Laboratory is a small-scale version of what could one day be built in Yreka, California.

Wood You Believe?

In 1985, the U.S. Postal Service helped FPL celebrate 75 years of wood research with this commemorative postcard.



FPL Partner WholeTrees Wins Business Concept Challenge

Concept Helps Create New Markets for Small-Diameter Logs from Forest Restoration

by Rebecca Wallace

Long-time Forest Products Laboratory (FPL) partner WholeTrees Architecture and Structures was named winner of the 2015 Barrett Foundation Business Concept Challenge by the National Forest Foundation and awarded a $75,000 prize. This unique business plan competition awards the best entrepreneurial approaches that address the challenges facing America's 193-million-acre National Forest System.

"It's an honor to have our company recognized by a business luminary like Dr. Barrett," says WholeTrees co-founder Amelia Baxter. "We provide an incentive for healthy forest management by taking what would otherwise be forest waste and transforming it into a highly valued construction material. It's a delight to see this approach honored on a national stage."

WholeTrees applies 21st century tools and know-how to the task of designing, engineering, and manufacturing innovative round timber structural systems for commercial and residential buildings. By using cutting-edge fastening techniques and patented technologies, WholeTrees allows builders to use entire small-diameter trees as a cost-effective, sustainable replacement for steel and milled lumber in numerous building applications.

Small-diameter trees are a low-value by-product of forest management, and developing markets for this by-product has been a challenge for land managers and businesses. WholeTrees advances the use of these products and creates a market for this material, while creating local jobs, improving forest management, and storing carbon.

First runner-up and winner of $25,000, Klickitat Community Forest Products is building a new model for processing small-diameter timber that produces efficiencies and results in increased profits and restoration of National Forests. Using high-efficiency, low-impact, cut-to-length logging systems, logs are merchandised in the field and delivered, unsorted, to Klickitat's transportable manufacturing facility at a central location. Logs are then graded for four end products: variable-width pine and fir flooring, 1–2-in. non-graded S4S lumber, bundled and bulk firewood, and fence posts and agricultural poles.

By vertically and horizontally integrating lumber operations and capitalizing on efficiencies gained through this integration, Klickitat Community Forest Products will improve the end market for small-diameter timber, providing a critical incentive for increased forest restoration.

WholeTrees Architecture & Structures

WholeTrees installed support beams and trusses in a Festival Foods grocery store, which opened this spring in Madison, Wisconsin.

"Both teams demonstrate a unique approach to removing a major barrier preventing more restoration work on our National Forests" says Leslie Weldon, Deputy Chief of the National Forest System. "By creating markets for small-diameter trees, the winning teams help create new opportunities for the Forest Service to achieve healthier forests and stimulate local economies. These are exactly the types of ideas we need to be nurturing across the country."

Partners in Crime: Forensic Botany Current Focus of Century-Old Collaboration

by Alex Wiedenhoeft, Rafael Arévalo, Adriana Costa, and Rebecca Wallace

Anything you can imagine can be used as evidence when investigating a crime, including wood, but it takes special skill to find the answers hidden within.

Enter Alex Wiedenhoeft, a Forest Products Laboratory (FPL) Research Botanist and Team Leader in the FPL's Center for Wood Anatomy Research (CWAR). The CWAR has long been the hub of activity when investigators find clues that involve wood in some way but need help deciphering what they've found.

"I've gotten evidence from murders or plane crashes…from university museums investigating African tribal masks, from Blackbeard's ship, even wood from inside a saber tooth tiger's skull," says Wiedenhoeft.

Alex Wiedenhoeft presents to the University of Wisconsin–Madison's Forensic Botany course.

Deriving information from wood is a niche skill, to be sure, and Wiedenhoeft is now sharing his expertise with the University of Wisconsin–Madison's Forensic Botany course. Students in the class recently toured the CWAR.

"This was an opportunity for the students to take a peek at the dirty white underbelly of scientific research, and see what a wood anatomy lab looks like," said Wiedenhoeft, one of the Botany Department professors co-teaching the course.

Wiedenhoeft and his CWAR research team showed the students a range of projects, from botanical wood anatomy exploring the evolution of plant form, to the nuts and bolts of ongoing forensic wood science research. "We're using their exposure to the realities of wood research as a backdrop for their capstone laboratory work in the class, where they will divide into teams, experts for the prosecution and defense, and work together to complete a forensic wood analysis," said Wiedenhoeft.

The wood collection in FPL's Center for Wood Anatomy contains more than 103,000 wood samples.

He won't divulge what cases the students will solve, but Wiedenhoeft indicated that one is a civil case involving alleged wood species substitution. He won't even hint at the criminal case. (A note of reassurance if the thought of botanists-in-training tackling legal cases makes you nervous: "These cases are completely fictional," Wiedenhoeft said, ensuring that no ongoing real-world cases could be jeopardized.)

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"A Miniature Forest of All the World's Forests"

by Francesca Yracheta

The United Kingdom's University of Bristol recently premiered an exhibit by artist Katie Paterson, with help from the Forest Products Laboratory (FPL). Contributions from FPL and numerous xylaria, herbaria, arboretums, and collectors from around the world were gathered to create *Hollow*, which is made of more than 10,000 unique tree species.

Spanning millions of years, *Hollow* is a miniature forest of all the world's forests. The exterior cluster structure reflects a forest canopy's ecosystem, the forms of the Douglas-fir posts reflecting the various heights of trees. The interior of *Hollow* tells the history of the planet, from petrified wood fossils from the earliest forests that emerged 390 million years ago to the most recent emergent species.

The exterior cluster structure reflects a forest canopy's ecosystem, the forms of the Douglas-fir posts reflecting the various heights of trees.

The interior tells the history of the planet, from petrified wood fossils from the earliest forests that emerged 390 million years ago to the most recent emergent species.

As the home of the world's largest research wood collection, which contains more than 103,000 samples, FPL was a natural source for Paterson's project.

FPL contributed cherry, ash, yellow poplar, red oak, white oak, sugar maple, myrtlewood, tan oak, Pacific madrone, Eastern white pine, Eastern hemlock, spruce, Northern white cedar, and Douglas-fir to help Paterson breathe life into the installation.

FPL Contributes to Hollow, a University of Bristol Art Installation

Paterson gathered fossilized samples, as well, including the Indian banyan tree, which sheltered Buddha following his journey to enlightenment. Even the Japanese ginko tree, a species that survived the bombing of Hiroshima, makes an appearance.

"Some samples are incredibly rare," Paterson said. "Fossils of unfathomable age and fantastical trees, such as cedar of Lebanon, the Phoenix palm, and the Methuselah tree, thought to be one of the oldest trees in the world at 4,487 years of age" are featured.

The artist also incorporated pieces of recent history with the addition of segments from the Atlantic City Boardwalk, which was destroyed by Hurricane Sandy in 2012.

Hollow is the result of three years of collaboration among Paterson, architectural firm Zeller & Moye, and Bristol-based art producers Situations. Commissioned by the University of Bristol, the artwork premiered in honor of the university's multi-million-dollar Life Sciences building, opened by British broadcaster and naturalist Sir David Attenborough in late 2014.

Hollow is open to the public and located at Royal Fort Gardens, Bristol, UK.

For more information, visit www.hollow.org.uk

Photos by Max McClure

As Axes Fall, Local Economy Rises: Cutting Costs While Cutting Trees

by Tom Owens

Taking care of urban forests may include the removal of diseased and damaged trees. Sometimes the axe must fall, and professionals must be called in to remove trees due to storms, disease, or invasive insects. Removal costs can add up quickly—in some cases, to the tune of several million dollars. Through careful planning, however, researchers, marketing teams, and industry professionals can find more affordable solutions—ones beneficial to the forests, the bottom line, and the local economy.

Kenosha County, Wisconsin, is ground zero for a large-scale urban wood utilization project where a mechanized cut-to-length (CTL) tree harvester is removing 5,400 trees that have succumbed to Emerald Ash Borer. These trees are located across the community, including in county parks and golf courses. Despite the scale of this operation, the cost to remove the trees is relatively low—just $13 a tree.

The CTL tree harvester is *removing 5,400 trees in Kenosha County that succumbed to Emerald Ash Borer.*

For the removal operation, Kenosha County enlisted the help of Don Peterson, Executive Director of Sustainable Resources Institute, and an important Forest Service program delivery partner. To keep costs down, Peterson sought out local businesses wherever possible; the winning bid for the harvesting, for example, went to a logger from nearby Oshkosh, Wisconsin.

Use of the CTL harvester provides usable wood for a variety of local industries, too, and the actual tree removal is not the only part of the project to benefit local business. Several entities plan to reuse the removed wood locally. Recovered products (pulpwood, sawbolts, and hardwood sawlogs) all went to local Wisconsin forest products companies. By ensuring that the diseased trees have a future before the first cut is made, the forest-to-market supply chain is kept intact.

Trees harvested from Kenosha County, in southeast Wisconsin, will benefit several communities around the area.

In addition, Kenosha County hosted a workshop for city arborists and others interested in urban wood utilization. The day-long event was partially funded by the USDA Forest Service's Wood Education Resource Center and the Forest Products Laboratory's Forest Products Marketing Unit (FPMU). Through this workshop, the public was able to learn about the operation and see first-hand the methods employed to manage our urban forests.

The Forest Service hopes to learn a thing or two from the Kenosha operation, too. FPMU believes that the project demonstrates the effectiveness of "forest-to-market supply chain" thinking. Similar efforts could efficiently remove and utilize woody biomass from land restoration and fuel reduction projects in our clogged forests—particularly in the western United States, where fire danger continues to climb.

iStockPhoto.com

As researchers continue to find new uses for low-value wood through emerging technologies like nanocellulose, demand for such material will only increase. Keeping costs low will be important for making urban wood utilization operations attractive. The tree removal project in Kenosha County shows that by considering the supply chain, utilizing local businesses, and educating the public, tree removal can benefit local communities as we cut costs and trees alike.

All In a Day's Work: Identifying Wood Species in Antique Horse Hames

by Rebecca Wallace

Mike Wiemann, a botanist in the Forest Products Laboratory's (FPL) Center for Wood Anatomy Research, has a special skill: identifying wood species, often with just a quick look through a tiny hand lens he carries in his pocket.

While most of us simply see wood, Wiemann can recognize various species by looking at the end grain and evaluating the size and arrangement of the tissue components. And he did just that recently for a visitor to the Lab with a unique collection.

Willis Parker has collected nearly 400 hames over several decades.

Willis Parker, a retired veterinarian, has an extensive collection of hames, two curved pieces of iron or wood forming (or attached to) the collar of a draft horse. Parker has collected nearly 400 hames over several decades, and is working to clean, photograph, identify wood species, and name the makers to preserve the history of their use.

Interestingly, Wiemann happened to know what a hame was thanks to his college days. "In 1964, a requirement of the Intro to Forestry class I took my freshman year was to memorize and identify the parts of a harness," said Wiemann. "I never thought I'd use that information again!"

With special permission from Wiemann (whose skills are in high demand), Parker brought 22 hames to FPL one sunny afternoon for wood identification. Some were well-worn and simple in design, used for work horses that pulled plows; others were painted and ornate, used when pulling carriages for wealthy passengers.

Parker laid out the pieces of wood, most dating from the early 1900s, and Wiemann got to work. What he found were hames made from ash, beech, red oak, white oak, hard maple, and elm.

Parker carefully tagged and labeled each hame after Wiemann announced the species, and he thanked Wiemann repeatedly for helping gather such useful information about his collection.

Wiemann was more than happy to help, as here at FPL, public service really is all in a day's work.

Willis Parker (left) shows FPL botanist Mike Wiemann his hame collection.

Wiemann prepares a wood sample for identification.

Hames in Parker's collection, most dating from the early 1900s, range from purely functional to decoratively ornate.

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Partners in Crime

A Historic Collaboration

At first glance, courses in forensic botany or forensic wood science may look like a novelty, but the CWAR and the UW have a long history of working together on forensic matters, from questions about the kind of wooden stick found in a plastic bottle to plant material as a feedstock for the synthesis of illegal drugs. In fact, the two have partnered in various ways for nearly a century.

The first and most obvious place these groups come together is in academic lineages for CWAR leadership, which go back at least to the 1920s. The first Project Leader of the CWAR, and the first female scientist in the Forest Service, Eloise Gerry, earned her Ph.D. in the UW Departments of Botany and Plant Pathology in 1921.

Eloise Gerry, the first female Forest Service scientist, began her career at FPL in 1910.

Several decades pass with no recorded affiliations, until Robert Koeppen became a student of legendary former UW Herbarium Director Hugh Iltis. Koeppen went on to be Project Leader of the CWAR from 1975 to 1980. The next Project Leader in the CWAR succession (1980–2005), Regis Miller, had been a Master's student of the UW's Ray Evert in the 1960s and also became an Adjunct Professor of Botany at the UW.

The current Team Leader for the CWAR, Alex Wiedenhoeft, was an undergraduate student of Ray Evert, earned both his M.S. and Ph.D. in Botany with Paul Berry, and now is an Adjunct Assistant Professor in the Department. All senior staff in the CWAR have some official appointment within the Department. Research Botanist Michael Wiemann is an Honorary Fellow affiliated through Ken Cameron. Rafael Arévalo and Adriana Costa are Honorary Fellows affiliated through Wiedenhoeft and are also working in his lab as postdocs.

Internships for Botany Department students, undergraduate and graduate, have been an important part of CWAR's contact and interaction with the UW. Alumni of CWAR student programs include Wiedenhoeft (B.S., M.S., Ph.D. – Berry), Terra Theim (B.S., Ph.D. – Givnish), Deniz Aygoren (M.S. – Cameron), Brian Sidoti (Ph.D. – Cameron), Rafael Arévalo (Ph.D. – Cameron), and Giovanny Giraldo (current Ph.D. student – Cameron).

The two institutions have another historic guest relationship—lectures on wood anatomy and wood identification in Sara Hotchkiss' Dendrology and Marisa Otegui's Plant Anatomy classes. Now, Wiedenhoeft and Hotchkiss have teamed up to develop and teach Forensic Botany. Arévalo presented a guest lecture on plant poisons in the course, and Costa has assisted in developing the hands-on laboratory activities.

David Tenenbaum, University Communications/ University of Wisconsin–Madison

Sara Hotchkiss, associate professor of botany at the University of Wisconsin, analyzes clues to vanished ecosystems contained in pollen. She occasionally offers an expert interpretation of pollen evidence in criminal cases.

The CWAR and UW Department of Botany have a reciprocal history in scientific collections, as well. In the early 2000s, the CWAR herbarium (MAD) was transferred on permanent loan to the Department's Wisconsin State Herbarium (WIS) facility, thanks in large part to a facilities grant awarded to house this collection in new compacting cabinets. A few years later, Ray Evert transferred the Katherine Esau and Vernon Cheadle phloem microscope slide collection to the CWAR, where it is now housed and accessioned. In this way, MAD is a permanent guest of the UW, as the slide collection is of the CWAR.

Looking to the Future

With growth of the CWAR research program in the past several years and a new level of cooperation between the UW Department of Botany and CWAR, opportunities for future collaboration are growing in basic and applied research, as well as collections management and curation.

Community engagement and outreach, especially in the coming years, is another area where the groups work together and share common goals. Staff want to bring science to the people and seek to inspire kids to ask questions about the natural world and to think seriously about careers in STEM-related

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Wood Wise — *Terms from the World of Wood*

Cambium: A thin layer of tissue between the bark and the wood that repeatedly subdivides to form new wood and bark cells.

Stringer: A timber or other support for cross members in floors or ceilings. In stairs, the support on which the stair treads rest.

Green: Freshly sawed or undried wood. Wood that has become completely wet after immersion in water would not be considered green but may be said to be in the "green condition."

Dote: "Dote", "doze", and "rot" are synonymous with "decay" and are any form of decay that may be evident as either a discoloration or a softening of the wood.

Incising: A pretreatment process in which incisions, slits, or perforations are made in the wood surface to increase penetration of preservative treatments. Incising is often required to enhance durability of some difficult-to-treat species, but incising reduces strength.

Staypak: Wood that is compressed in its natural state (that is, without resin or other chemical treatment) under controlled conditions of moisture, temperature, and pressure that practically eliminate springback or recovery from compression. The product has increased density and strength characteristics.

Source

Wood Handbook—Wood as an Engineering Material

General Technical Report FPL–GTR–190

www.fpl.fs.fed.us/woodhandbook

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Partners in Crime

fields (science, technology, engineering, and mathematics). Because the CWAR and the Botany Department share similar goals in their desire for outreach, staff worked together to translate their passion for, and the relevance of, plant research to a module about tree growth, wood evolution, and wood anatomy. This development improves public access to basic plant science research and information.

Through continued work with the UW Department of Botany, CWAR is looking forward to building a new foundation for the next century of collaboration.

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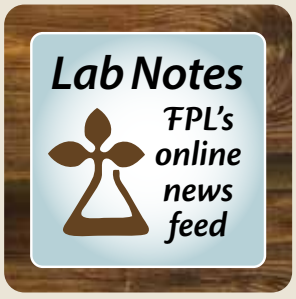

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